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Environmental Radiation Data: Report 57, January-March 1989

(U.S.) Eastern Environmental Radiation Facility, Montgomery, AL

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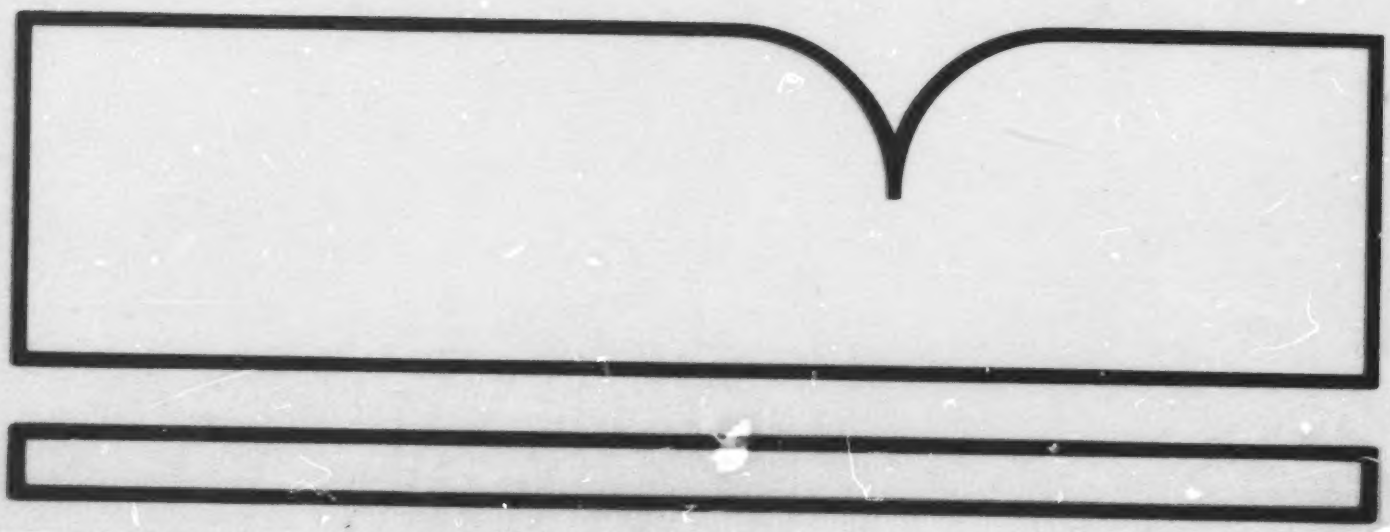

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September 1989

Radiation

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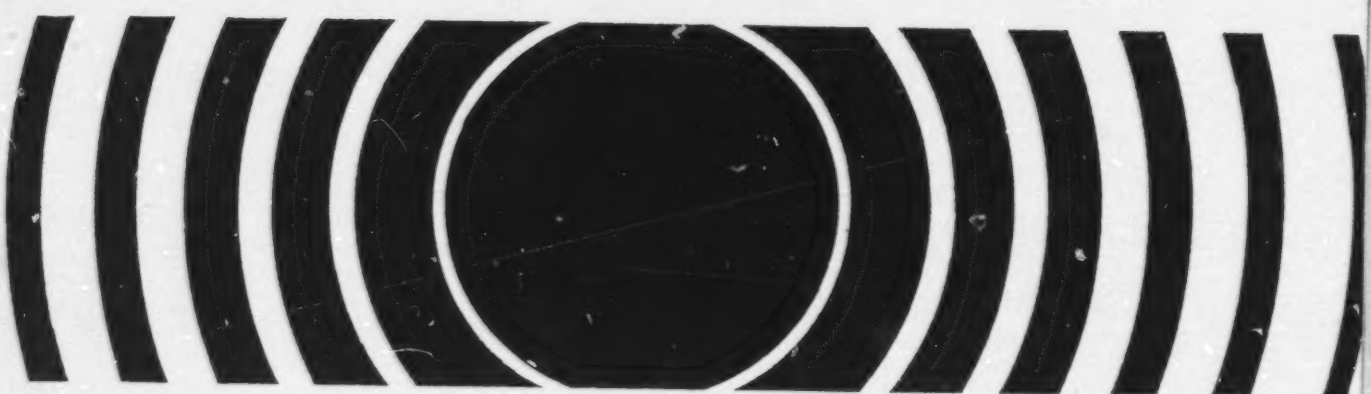
Environmental Radiation Data

Report 57

January - March 1989



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16. ABSTRACT

Environmental Radiation Data (ERD) contains data from the Environmental Radiation Ambients Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available.

The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water and milk samples from which environmental radiation levels are derived. Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, stronium, iodine, radium, krypton, and tritium.

17. KEY WORDS AND DOCUMENT ANALYSIS

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ENVIRONMENTAL RADIATION DATA

REPORT 57

January - March 1989

United States Environmental Protection Agency

Office of Radiation Programs

Environmental Radiation Data (ERD) is compiled and distributed quarterly by the Office of Radiation Programs' Eastern Environmental Radiation Facility (EERF) in Montgomery, Alabama, and contains data from the Environmental Radiation Ambient Monitoring System (ERAMS). Data from similar networks operated by contributing States, Canada, Mexico, and the Pan American Health Organization are reported in the ERD when available.

ERAMS was established in 1973 by the U. S. Environmental Protection Agency's Office of Radiation Programs (ORP). The ERAMS is comprised of nationwide sampling stations that provide air, surface and drinking water, and milk samples from which environmental radiation levels are derived. The major emphasis for ERAMS is upon identifying trends in the accumulation of long-lived radionuclides in the environment.

Sampling locations are selected to provide optimal population coverage while functioning to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The radiation analyses performed on these samples include gross alpha and gross beta levels, gamma analyses for fission products, and specific analyses for uranium, plutonium, strontium, iodine, radium, krypton, and tritium. This monitoring effort also provides ancillary information on natural background levels and on routine and accidental releases into the environment from stationary sources.

The radiochemical procedures used by the EERF to analyze the ERAMS samples are contained in *Eastern Environmental Radiation Facility Radiochemistry Procedures Manual* (EPA 520/5–84–006). Station operation and sample collection are in accordance with procedures contained in the *ERAMS Manual* (EPA 520/5–84–007, 008, 009).

Environmental Radiation Data

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DATA - Reporting Rationale and Procedures

In 1973, the U.S. Environmental Protection Agency's Office of Radiation Programs established the Environmental Radiation Ambient Monitoring System (ERAMS) to provide continuous, accurate, and usable environmental radiation data to the public. For completeness, ERAMS data for all specific radionuclide analyses are reported as the calculated results indicate, whether the numbers are negative, zero, or positive.

Reporting Rationale

Frequently, there is little or no radioactivity in environmental media. Thus, the results of laboratory analyses should statistically show a distribution of negative and positive numbers about zero. A negative value occurs when a previously determined background value is subtracted from a sample value that is less than that of the background. Prior to July 1975, ERAMS data were not reported numerically when the results were less than a specified reporting level or minimum detectable level. The present reporting procedure allows all the data to be reported and evaluated statistically without an arbitrary cutoff of small or negative numbers. This approach will facilitate estimates of bias in the nuclide analyses and will allow better evaluation of distributions and trends in environmental data.

When reviewing the data in this report, caution should be exercised in the interpretation of individual negative values. Obviously, a negative activity value has no physical significance. Such numbers, however, are significant when taken together with other observations that indicate that the true value of a distribution is near zero. When an average of many measurements produces a result significantly less than zero, this indicates a bias in the measurement procedure.

(1) *Reported Values*

Specific Analyses. All specific radionuclide analyses will be reported as the counting results indicate, whether the value is negative, zero, or positive. All reported values are corrected for radioactive decay to the collection date.

Gross Analyses. The actual value of gross radioactivity measurements will be reported, unless the value is below the minimum detectable level (MDL) at the 2σ confidence level, then $<$ minimum detectable level will be reported.

MDL is defined as the 3σ error of the background. A tabulation of typical MDL's is given in the following table.

(2) *Reported Error Terms*

Each reported value for specific analyses will be accompanied by a counting error term at the 2σ (95%) confidence interval. Error terms are therefore reported as counting errors. At the very low levels characteristic of most ERAMS measurements, counting error is the greatest contributor to overall error.

(3) *Significant Figures*

No more than three significant figures will be reported. If a datum contains more than three figures, it will be rounded off to three figures.

(4) *Reporting Levels*

The reporting units, smallest increments for reporting, and typical minimum detectable levels for each isotope are shown in Table 1. Reporting increments are sometimes considerably smaller than minimum detectable amounts to avoid truncation errors in averaging.

(5) *Averages*

Averages will be calculated along with appropriate error terms in an annual summary and analysis of ERAMS data. In calculating these averages, all values of individual data including negative numbers will be utilized. Averages will not be included in ERD quarterly reports.

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Table 1

ERAMS Reporting Increments and Minimum Detectable Levels for Radionuclide Analyses

Radionuclide	Media	Reporting Units	Reporting Increments	Minimum Detectable Levels
Gross Alpha	Water	pCi/l	1 pCi/l	2 pCi/l
† Gross Beta	Air	pCi/m^3	0.01 pCi/m^3	0.01 pCi/m^3
	Water	pCi/l	1 pCi/l	1 pCi/l
	Precipitation	nCi/m^2	0.01 nCi/m^2	0.01 nCi/m^2
	(specific radiochemical analyses)			
Tritium	Water	nCi/l	0.1 nCi/l	0.2 nCi/l
	Milk	nCi/l	0.1 nCi/l	0.2 nCi/l
Carbon-14	Milk	pCi/l	1 pCi/l	15 pCi/l
Krypton-85	Ambient Air	pCi/m^3	0.1 pCi/m^3	2 pCi/m^3
†† Plutonium-238,239,240	Air	aCi/m^3	0.1 aCi/m^3	0.015 pCi
	Milk	pCi/l	0.001 pCi/l	0.015 pCi
	Water	pCi/l	0.001 pCi/l	0.015 pCi
‡ Uranium-234,235,238	Air	aCi/m^3	0.1 aCi/m^3	0.015 pCi
	Milk	pCi/l	0.001 pCi/l	0.015 pCi
	Water	pCi/l	0.001 pCi/l	0.015 pCi
Radium-226	Water	pCi/l	0.1 pCi/l	0.1 pCi/l
Strontium-90	Milk	pCi/l	0.1 pCi/l	1 pCi/l
	Water	pCi/l	0.1 pCi/l	1 pCi/l
‡‡ Strontium-89	Milk	pCi/l	1 pCi/l	5 pCi/l
‡‡ Iodine-131	Milk	pCi/l	1 pCi/l	10 pCi/l
	Water	pCi/l	1 pCi/l	10 pCi/l
	Water	pCi/l	0.1 pCi/l	0.4 pCi/l
Iodine-129	Milk	fCi/l	0.1 fCi/l	0.4 fCi/l
Cesium-137	Milk	pCi/l	1 pCi/l	10 pCi/l
	Water	pCi/l	1 pCi/l	10 pCi/l
‡‡ Barium-140	Milk	pCi/l	1 pCi/l	10 pCi/l
	Water	pCi/l	1 pCi/l	10 pCi/l
Potassium	Milk	g/l	0.1 g/l	0.12 g/l
	Water	g/l	0.1 g/l	0.12 g/l
Potassium-40	Water	pCi/l	1 pCi/l	100 pCi/l

† The value of MDL for precipitation in terms of nCi/m^2 would be dependent on precipitation (mm).

†† This value of MDL for air in terms of pCi/m^3 would be dependent on the air volume. Measurement by alpha spectroscopy that includes contributions of plutonium-239 and plutonium-240. MDL for all media given per sample.

‡ This value of MDL for air in terms of pCi/m^3 would be dependent on the air volume. MDL for all media given per sample.

‡‡ Activity as of the day of counting.

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ENVIRONMENTAL RADIATION AMBIENT MONITORING SYSTEM (ERAMS)

Section I. Air Program

Airborne Particulates and Precipitation

Gross beta radioactivity measurements and certain specific analyses are performed on air particulates and precipitation samples as indicator measurements in assessing the general (national) impact of all contributing sources on environmental levels of radiation.

Airborne particulates are collected continuously at field stations representing wide geographic coverage, including present and potential sources of environmental radioactivity. Sampling sites are located throughout the United States.

Filters (10–cm diameter synthetic fiber) from air samplers are changed twice weekly and field measurements are made with a G-M survey meter [1] at 5 hours and 29 hours after collection to allow for radon and thoron daughter product decay. Field estimates are reported to appropriate EPA officials by telephone or mail depending on the activity levels found.

The filters are sent to EERF for more sensitive analyses in a low background beta counter. Gamma scans are performed on all filters showing gross beta counts greater than 1 pCi/m^3. The laboratory obtained values are usually lower than the field estimates due to the decay of naturally occurring radionuclides between the times of the two measurements.

Precipitation samples are collected at those field stations collecting air filters. These samples are also sent to EERF where they are composited monthly for gamma scans, tritium, and gross beta activity measurements. A composite of the March, April, and May precipitation samples is analyzed for plutonium–238, –239, –240, and uranium–234, –235, and –238.

A compilation of individual measurements is available from the Eastern Environmental Radiation Facility, 1890 Congressman W.L. Dickinson Drive, Montgomery, AL 36109.

Tables 2–4 contain the data in airborne particulate samples for January - March 1989. Tables 5–7 contain the data in precipitation sample for January - March 1989. Table 8 contains the data for tritium in precipitation samples for January - March 1989 at the selected sites.

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[1] The counts at five hours for the Montgomery, Alabama, station are performed on a low background beta counter.

Table 2

Airborne Particulates
Gross Beta Concentrations

January 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m^3)			EERF Lab Measurment (pCi/m^3)		
		Max	Min	Avg	Max	Min	Avg
AL:MONTGOMERY	9	0.6	0.2	0.4	0.02	0.01	0.01
AR:LITTLE ROCK	9	0.2	0.1	0.1	0.02	0.01	0.02
AZ:PHOENIX	4	2.0	0.0	0.5	0.02	0.01	0.01
CA:BERKELEY	9	0.0	0.0	0.0	0.03	0.00	0.01
CA:LOS ANGELES	9	0.4	0.1	0.2	0.05	0.01	0.02
CO:DENVER	9	0.6	0.1	0.3	0.08	0.01	0.02
CT:HARTFORD	7	0.1	0.0	0.1	0.02	0.00	0.01
DE:WILMINGTON	8	0.3	0.0	0.1	0.02	0.01	0.01
FL:JACKSONVILLE	9	0.4	0.0	0.1	0.02	0.01	0.01
FL:MIAMI	7	0.0	0.0	0.0	0.01	0.00	0.00
HI:HONOLULU	9	0.2	0.1	0.2	0.00	0.00	0.00
IA:IOWA CITY	8	0.2	0.1	0.1	0.05	0.01	0.03
ID:BOISE	9	0.3	0.0	0.1	0.04	0.00	0.02
ID:IDAHO FALLS	8	0.0	0.0	0.0	0.03	0.01	0.02
IL:CHICAGO	9	0.4	0.1	0.2	0.04	0.01	0.02
IN:INDIANAPOLIS	9	0.2	0.1	0.1	0.03	0.01	0.02
KS:TOPEKA	8	2.0	0.8	1.1	0.04	0.01	0.02
KY:FRANKFORT	5	0.5	0.1	0.2	0.03	0.01	0.02
LA:NEW ORLEANS	7	0.1	0.0	0.1	0.02	0.01	0.01
MA:LAWRENCE	8	0.3	0.0	0.1	0.02	0.01	0.02
ME:AUGUSTA	7	0.1	0.0	0.1	0.02	0.01	0.01
MI:LANSING	9	0.1	0.0	0.1	0.02	0.01	0.02
MN:MINNEAPOLIS	9	0.3	0.0	0.1	0.04	0.01	0.02
MO:JEFFERSON CITY	9	0.5	0.1	0.3	0.03	0.01	0.02
MS:JACKSON	9	0.2	0.0	0.1	0.02	0.01	0.02
NC:CHARLOTTE	9	0.2	0.0	0.1	0.02	0.01	0.01
NC:WILMINGTON	9	0.0	0.0	0.0	0.02	0.01	0.01
ND:BISMARCK	8	0.2	0.1	0.1	0.05	0.01	0.02
NE:LINCOLN	9	1.9	0.1	0.9	0.10	0.01	0.03
NH:CONCORD	9	0.1	0.0	0.0	0.01	0.01	0.01
NJ:TRENTON	9	0.4	0.1	0.2	0.02	0.01	0.01
NM:SANTA FE	8	0.4	0.1	0.3	0.02	0.01	0.01
NV:LAS VEGAS	9	0.3	0.1	0.2	0.03	0.01	0.02
NY:ALBANY	5	0.1	0.0	0.0	0.03	0.01	0.02
NY:NEW YORK CITY	9	0.2	0.1	0.1	0.02	0.01	0.02
NY:NIAGARA FALLS	9	0.2	0.0	0.1	0.02	0.01	0.02
NY:SYRACUSE	3	1.0	0.0	0.3	0.01	0.01	0.01

Table 2 (continued)

Airborne Particulates
Gross Beta Concentrations

January 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m³)			EERF Lab Measurment (pCi/m³)		
		Max	Min	Avg	Max	Min	Avg
NY:YAPHANK	7	0.1	0.0	0.1	0.01	0.01	0.01
OH:COLUMBUS	8	0.3	0.0	0.1	0.02	0.01	0.02
OH:PAINESVILLE	9	0.2	0.0	0.1	0.03	0.01	0.02
OH:TOLEDO	9	0.3	0.0	0.1	0.03	0.01	0.02
OK:OKLAHOMA CITY	9	1.3	0.3	0.6	0.08	0.01	0.03
OR:PORTLAND	9	0.0	0.0	0.0	0.01	0.00	0.00
PA:GOLDSBORO	9	0.2	0.0	0.1	0.03	0.01	0.02
PA:HARRISBURG	9	0.3	0.0	0.2	0.02	0.01	0.02
PA:PITTSBURGH	9	0.1	0.1	0.1	0.03	0.01	0.01
PA:THREE MILE ISLAND	9	0.6	0.0	0.2	0.03	0.01	0.02
RI:PROVIDENCE	6	0.2	0.0	0.1	0.03	0.01	0.02
SC:BARNWELL	1	0.0	0.0	0.0	0.01	0.01	0.01
SC:COLUMBIA	9	0.3	0.1	0.2	0.04	0.01	0.02
SD:PIERRE	9	0.6	0.1	0.3	0.04	0.01	0.02
TN:KNOXVILLE	8	0.5	0.1	0.2	0.06	0.01	0.02
TN:NASHVILLE	9	0.2	0.1	0.1	0.03	0.01	0.02
TX:AUSTIN	9	0.3	0.1	0.2	0.02	0.01	0.01
TX:EL PASO	8	1.1	0.4	0.7	0.06	0.01	0.03
UT:SALT LAKE CITY	9	0.1	0.0	0.0	0.06	0.00	0.02
VA:LYNCHBURG	9	0.3	0.0	0.1	0.02	0.01	0.01
WA:OLYMPIA	9	0.1	0.0	0.1	0.01	0.00	0.00
WA:SPOKANE	9	0.1	0.0	0.1	0.01	0.00	0.01
WI:MADISON	9	0.2	0.0	0.1	0.04	0.01	0.02
WV:CHARLESTON	9	0.5	0.1	0.2	0.02	0.01	0.01
WY:CHEYENNE	2	0.0	0.0	0.0	0.01	0.00	0.00

Minimum Detectable Limit for field estimates – 0.1 pCi/m³.
Minimum Detectable Limit for laboratory measurement – 0.01 pCi/m³.

Table 3

Airborne Particulates
Gross Beta Concentrations

February 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m³)			EERF Lab Measurment (pCi/m³)		
		Max	Min	Avg	Max	Min	Avg
AL:MONTGOMERY	6	0.3	0.1	0.2	0.02	0.00	0.01
AR:LITTLE ROCK	8	0.1	0.0	0.1	0.03	0.01	0.01
AZ:PHOENIX	4	2.0	0.2	0.8	0.02	0.01	0.02
CA:BERKELEY	8	0.0	0.0	0.0	0.02	0.00	0.01
CA:LOS ANGELES	8	0.4	0.1	0.2	0.02	0.01	0.01
CO:DENVER	8	0.5	0.2	0.3	0.03	0.01	0.02
CT:HARTFORD	8	0.1	0.0	0.1	0.01	0.01	0.01
DE:WILMINGTON	8	0.1	0.1	0.1	0.01	0.01	0.01
FL:JACKSONVILLE	6	0.1	0.1	0.1	0.01	0.00	0.01
FL:MIAMI	7	0.1	0.0	0.1	0.01	0.00	0.01
HI:HONOLULU	8	0.4	0.1	0.2	0.06	0.00	0.01
IA:IOWA CITY	8	0.1	0.1	0.1	0.03	0.01	0.01
ID:BOISE	8	0.6	0.1	0.2	0.06	0.01	0.03
ID:IDAHO FALLS	8	0.0	0.0	0.0	0.03	0.01	0.02
IL:CHICAGO	8	0.1	0.0	0.1	0.02	0.01	0.01
IN:INDIANAPOLIS	8	0.2	0.0	0.1	0.02	0.01	0.01
KS:TOPEKA	7	0.9	0.2	0.5	0.02	0.01	0.01
KY:FRANKFORT	3	0.2	0.1	0.1	0.02	0.01	0.02
LA:NEW ORLEANS	5	0.2	0.0	0.1	0.01	0.01	0.01
MA:LAWRENCE	8	0.1	0.0	0.1	0.01	0.01	0.01
ME:AUGUSTA	8	0.1	0.0	0.0	0.02	0.01	0.01
MI:LANSING	8	0.1	0.0	0.1	0.02	0.01	0.01
MN:MINNEAPOLIS	8	0.2	0.0	0.1	0.02	0.00	0.01
MO:JEFFERSON CITY	8	2.3	0.2	0.5	0.02	0.01	0.01
MS:JACKSON	7	0.2	0.0	0.1	0.02	0.00	0.01
NC:CHARLOTTE	8	0.3	0.0	0.1	0.01	0.01	0.01
NC:WILMINGTON	8	0.0	0.0	0.0	0.01	0.01	0.01
ND:BISMARCK	6	0.2	0.1	0.1	0.04	0.01	0.02
NE:LINCOLN	6	0.5	0.0	0.3	0.02	0.01	0.01
NH:CONCORD	8	0.1	0.0	0.0	0.01	0.01	0.01
NJ:TRENTON	8	0.3	0.1	0.1	0.01	0.01	0.01
NM:SANTA FE	8	0.3	0.1	0.2	0.02	0.01	0.01
NV:LAS VEGAS	8	0.5	0.0	0.2	0.02	0.01	0.02
NY:ALBANY	3	0.0	0.0	0.0	0.02	0.01	0.01
NY:NEW YORK CITY	8	0.1	0.0	0.1	0.02	0.01	0.01
NY:NIAGARA FALLS	8	0.1	0.0	0.0	0.02	0.01	0.01
NY:SYRACUSE	3	0.0	0.0	0.0	0.02	0.01	0.01

Table 3 (continued)

Airborne Particulates
Gross Beta Concentrations

February 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m³)			EERF Lab Measurment (pCi/m³)		
		Max	Min	Avg	Max	Min	Avg
WY:YAPHANK	7	0.1	0.1	0.1	0.01	0.01	0.01
OH:COLUMBUS	6	0.1	0.0	0.1	0.02	0.01	0.01
OH:PAINESVILLE	8	0.1	0.0	0.1	0.02	0.01	0.01
OH:TOLEDO	8	0.1	0.0	0.1	0.02	0.01	0.01
OK:OKLAHOMA CITY	8	1.0	0.0	0.3	0.03	0.01	0.02
OR:PORTLAND	8	0.0	0.0	0.0	0.04	0.00	0.01
PA:GOLDSBORO	8	0.2	0.1	0.1	0.02	0.01	0.01
PA:HARRISBURG	8	0.3	0.0	0.1	0.02	0.01	0.01
PA:PITTSBURGH	8	0.0	0.0	0.0	0.02	0.01	0.01
PA:THREE MILE ISLAND	8	0.3	0.0	0.2	0.01	0.01	0.01
RI:PROVIDENCE	7	0.1	0.0	0.1	0.01	0.01	0.01
SC:BARNWELL	2	0.1	0.0	0.1	0.01	0.01	0.01
SC:COLUMBIA	7	0.6	0.1	0.2	0.02	0.01	0.01
SD:PIERRE	7	0.4	0.1	0.2	0.03	0.01	0.02
TN:KNOXVILLE	7	0.6	0.1	0.3	0.02	0.01	0.01
TN:NASHVILLE	8	0.1	0.0	0.1	0.03	0.00	0.01
TX:AUSTIN	7	0.2	0.1	0.1	0.02	0.01	0.01
TX:EL PASO	8	0.8	0.2	0.4	0.03	0.01	0.02
UT:SALT LAKE CITY	8	0.1	0.0	0.0	0.03	0.01	0.02
VA:LYNCHBURG	8	0.4	0.1	0.2	0.01	0.01	0.01
WA:OLYMPIA	8	0.1	0.0	0.1	0.02	0.00	0.01
WA:SPOKANE	8	0.1	0.0	0.1	0.04	0.01	0.02
WI:MADISON	8	0.1	0.0	0.1	0.03	0.01	0.01
WV:CHARLESTON	7	0.1	0.0	0.0	0.01	0.00	0.01
WY:CHEYENNE	2	0.0	0.0	0.0	0.02	0.01	0.01

Minimum Detectable Limit for field estimates – 0.1 pCi/m³.
Minimum Detectable Limit for laboratory measurement – 0.01 pCi/m³.

Table 4

Airborne Particulates
Gross Beta Concentrations

March 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m³)			EERF Lab Measurment (pCi/m³)		
		Max	Min	Avg	Max	Min	Avg
AL:MONTGOMERY	8	0.3	0.1	0.2	0.01	0.00	0.01
AR:LITTLE ROCK	9	0.4	0.0	0.2	0.02	0.01	0.01
AZ:PHOENIX	8	3.4	0.0	1.4	0.03	0.01	0.02
CA:BERKELEY	9	0.0	0.0	0.0	0.00	0.00	0.00
CA:LOS ANGELES	9	0.4	0.0	0.2	0.01	0.00	0.01
CO:DENVER	9	1.0	0.3	0.7	0.02	0.01	0.01
CT:HARTFORD	9	0.1	0.0	0.1	0.01	0.00	0.01
DE:WILMINGTON	9	0.1	0.0	0.1	0.01	0.00	0.01
FL:JACKSONVILLE	8	0.2	0.0	0.1	0.01	0.00	0.01
FL:MIAMI	9	0.1	0.0	0.0	0.01	0.00	0.00
HI:HONOLULU	9	0.2	0.1	0.2	0.01	0.00	0.00
IA:IOWA CITY	9	0.3	0.1	0.1	0.02	0.01	0.01
ID:BOISE	9	0.2	0.1	0.2	0.01	0.00	0.01
ID:IDAHO FALLS	9	0.0	0.0	0.0	0.02	0.00	0.01
IL:CHICAGO	8	0.2	0.0	0.1	0.02	0.01	0.01
IN:INDIANAPOLIS	9	0.2	0.0	0.1	0.02	0.01	0.01
KS:TOPEKA	8	1.7	0.2	0.9	0.02	0.01	0.01
KY:FRANKFORT	3	0.2	0.1	0.1	0.01	0.01	0.01
LA:NEW ORLEANS	7	0.1	0.0	0.1	0.01	0.00	0.01
MA:LAWRENCE	9	0.1	0.0	0.1	0.02	0.01	0.01
ME:AUGUSTA	8	0.1	0.0	0.0	0.02	0.01	0.01
MI:LANSING	9	0.2	0.0	0.0	0.01	0.01	0.01
MN:MINNEAPOLIS	9	0.3	0.0	0.1	0.02	0.01	0.01
MO:JEFFERSON CITY	9	0.8	0.1	0.3	0.02	0.01	0.01
MS:JACKSON	8	0.4	0.0	0.1	0.01	0.00	0.01
NC:CHARLOTTE	8	0.1	0.0	0.1	0.01	0.00	0.01
NC:WILMINGTON	7	0.0	0.0	0.0	0.01	0.00	0.01
ND:BISMARCK	6	1.3	0.1	0.3	0.02	0.01	0.01
NE:LINCOLN	8	1.6	0.1	0.8	0.02	0.01	0.01
NH:CONCORD	9	0.1	0.0	0.1	0.01	0.01	0.01
NJ:TRENTON	9	0.2	0.0	0.1	0.01	0.00	0.01
NM:SANTA FE	7	0.4	0.1	0.3	0.01	0.01	0.01
NV:LAS VEGAS	9	0.3	0.1	0.2	0.02	0.01	0.01
NY:ALBANY	4	0.0	0.0	0.0	0.02	0.01	0.01
NY:NEW YORK CITY	9	0.3	0.0	0.1	0.02	0.01	0.01
NY:NIAGARA FALLS	9	0.1	0.0	0.1	0.02	0.01	0.01
NY:SYRACUSE	4	0.2	0.0	0.1	0.01	0.00	0.01

Table 4 (continued)

Airborne Particulates
Gross Beta Concentrations

March 1989

Location	Number of Samples	5-Hour Field Estimate (pCi/m^3)			EERF Lab Measurment (pCi/m^3)		
		Max	Min	Avg	Max	Min	Avg
NY:YAPHANK	9	0.2	0.0	0.1	0.01	0.00	0.01
OH:COLUMBUS	6	0.2	0.0	0.1	0.01	0.01	0.01
OH:PAINESVILLE	9	0.2	0.0	0.1	0.02	0.01	0.01
OH:TOLEDO	9	0.5	0.0	0.1	0.01	0.01	0.01
OK:OKLAHOMA CITY	6	0.9	0.1	0.5	0.02	0.01	0.02
OR:PORTLAND	9	0.0	0.0	0.0	0.01	0.00	0.00
PA:GOLDSBORO	9	0.4	0.0	0.2	0.01	0.01	0.01
PA:HARRISBURG	9	0.2	0.0	0.1	0.02	0.01	0.01
PA:PITTSBURGH	9	0.0	0.0	0.0	0.01	0.01	0.01
PA:THREE MILE ISLAND	8	0.2	0.0	0.1	0.01	0.01	0.01
RI:PROVIDENCE	9	0.2	0.0	0.1	0.01	0.01	0.01
SC:BARNWELL	1	0.0	0.0	0.0	0.01	0.01	0.01
SC:COLUMBIA	8	0.3	0.0	0.2	0.01	0.01	0.01
SD:PIERRE	6	0.8	0.0	0.3	0.02	0.01	0.01
TN:KNOXVILLE	9	0.6	0.1	0.3	0.02	0.01	0.01
TN:NASHVILLE	9	0.7	0.0	0.2	0.02	0.00	0.01
TX:AUSTIN	7	0.3	0.1	0.2	0.02	0.00	0.01
TX:EL PASO	8	0.9	0.2	0.5	0.02	0.01	0.01
UT:SALT LAKE CITY	9	0.3	0.0	0.1	0.02	0.01	0.01
VA:LYNCHBURG	9	0.6	0.1	0.3	0.01	0.01	0.01
WA:OLYMPIA	9	0.1	0.0	0.0	0.01	0.00	0.00
WA:SPOKANE	9	0.2	0.0	0.1	0.01	0.00	0.00
WI:MADISON	9	0.4	0.0	0.1	0.01	0.01	0.01
WV:CHARLESTON	9	0.2	0.0	0.1	0.02	0.01	0.01
WY:CHEYENNE	4	0.4	0.1	0.3	0.01	0.01	0.01

Minimum Detectable Limit for field estimates – 0.1 pCi/m^3.
Minimum Detectable Limit for laboratory measurement – 0.01 pCi/m^3.

Table 5

Gross Beta Concentrations in Precipitation

January 1989

Location	Depth (mm)	Act. $\pm 2\sigma$ (nCi/m^2)		Specific Gamma Activity
AL:MONTGOMERY	86.6	0.20	0.05	ND
AR:LITTLE ROCK	44.0	0.01	0.02	ND
AZ:PHOENIX	20.0	0.01	0.01	ND
CA:BERKELEY	49.2	0.00	0.02	ND
CO:DENVER	10.4	0.01	0.00	ND
CT:HARTFORD	16.0	0.06	0.01	ND
FL:JACKSONVILLE	43.0	0.03	0.02	ND
FL:MIAMI	9.8	0.01	0.00	ND
ID:BOISE	38.4	0.02	0.01	ND
LA:NEW ORLEANS	57.8	0.03	0.02	ND
MA:LAWRENCE	24.0	0.04	0.01	ND
MN:MINNEAPOLIS	2.0	0.00	0.00	ND
MO:JEFFERSON CITY	41.0	0.10	0.02	ND
MS:JACKSON	80.0	0.10	0.04	ND
NC:CHARLOTTE	42.0	0.02	0.02	ND
NC:WILMINGTON	56.0	0.02	0.02	ND
ND:BISMARCK	3.0	0.02	0.00	ND
NJ:TRENTON	34.7	0.04	0.02	ND
NV:LAS VEGAS	9.0	0.00	0.00	ND
NY:ALBANY	15.0	0.00	0.01	ND
NY:NEW YORK CITY	39.6	0.02	0.02	ND
NY:NIAGARA FALLS	29.0	0.01	0.01	ND
NY:YAPHANK	31.0	0.05	0.02	ND
OH:PAINESVILLE	49.0	0.19	0.03	ND
OK:OKLAHOMA CITY	33.0	0.02	0.01	ND
OR:PORTLAND	96.0	0.14	0.05	ND
PA:HARRISBURG	7.0	0.01	0.00	ND
PA:MIDDLETOWN	38.0	0.04	0.02	ND
SC:COLUMBIA	65.2	0.05	0.03	ND
TN:KNOXVILLE	157.4	0.07	0.08	ND

Table 5 (continued)

Gross Beta Concentrations in Precipitation

January 1989

Location	Depth (mm)	Act. $\pm 2\sigma$ (nCi/m^2)		Specific Gamma Activity
TN:NASHVILLE	152.8	0.06	0.08	ND
TX:AUSTIN	15.0	0.01	0.01	ND
UT:SALT LAKE CITY	10.0	0.02	0.01	ND
VA:LYNCHBURG	28.4	0.05	0.01	ND
WA:OLYMPIA	149.2	0.06	0.06	ND
WI:MADISON	83.2	0.03	0.04	ND
WV:CHARLESTON	39.6	0.02	0.02	ND

σ = Sigma Counting Error.
NA = Not Analyzed.
ND = No Gamma Activity Detectable.

Table 6

Gross Beta Concentrations in Precipitation

February 1989

Location	Depth (mm)	Act. $\pm 2\sigma$ (nCi/m^2)		Specific Gamma Activity
AL:MONTGOMERY	63.2	0.23	0.04	ND
AR:LITTLE ROCK	169.0	0.11	0.07	ND
CA:BERKELEY	40.4	0.01	0.01	ND
CT:HARTFORD	35.0	0.07	0.02	ND
FL:JACKSONVILLE	19.0	0.01	0.01	ND
FL:MIAMI	14.0	0.06	0.01	ND
ID:BOISE	30.2	0.06	0.02	ND
ID:IDAHO FALLS	50.4	0.08	0.03	ND
IL:CHICAGO	23.2	0.11	0.02	ND
MA:LAWRENCE	42.0	0.12	0.07	ND
MN:MINNEAPOLIS	4.0	0.00	0.00	ND
MO:JEFFERSON CITY	40.0	0.05	0.02	ND
MS:JACKSON	41.0	0.16	0.03	ND
NC:CHARLOTTE	113.0	0.31	0.07	ND
NC:WILMINGTON	68.0	0.03	0.03	ND
NJ:TRENTON	77.0	0.04	0.03	ND
NY:NEW YORK CITY	42.6	0.06	0.02	ND
NY:NIAGARA FALLS	20.0	0.03	0.01	ND
NY:YAPHANK	70.0	0.09	0.03	ND
OH:PAINESVILLE	20.0	0.08	0.01	ND
OK:OKLAHOMA CITY	42.0	0.05	0.02	ND
OR:PORTLAND	53.0	0.04	0.02	ND
PA:HARRISBURG	114.2	0.32	0.07	ND
PA:MIDDLETOWN	45.0	0.07	0.02	ND
SC:BARNWELL	98.8	0.24	0.05	ND
SC:COLUMBIA	86.4	0.14	0.04	ND
TN:KNOXVILLE	96.0	0.22	0.05	ND
TN:NASHVILLE	199.2	0.47	0.12	ND
TX:EL PASO	20.0	0.02	0.01	ND
UT:SALT LAKE CITY	22.8	0.02	0.01	ND

Table 6 (continued)

Gross Beta Concentrations in Precipitation

February 1989

Location	Depth (mm)	Act. $\pm 2\sigma$ (nCi/m^2)		Specific Gamma Activity
VA:LYNCHBURG	24.4	0.05	0.01	ND
WA:OLYMPIA	151.0	0.22	0.07	ND
WI:MADISON	54.2	0.02	0.02	ND
WV:CHARLESTON	92.0	0.06	0.04	ND

σ = Sigma Counting Error.
NA = Not Analyzed.
ND = No Gamma Activity Detectable.

Table 7

Gross Beta Concentrations in Precipitation

March 1989

Location	Depth (mm)	Act.	±2σ (nCi/m²)	Specific Gamma Activity
AL:MONTGOMERY	155.6	0.07	0.06	ND
AR:LITTLE ROCK	141.0	0.08	0.06	ND
AZ:PHOENIX	8.0	0.00	0.00	ND
CA:BERKELEY	161.7	-0.02	0.06	ND
CO:DENVER	4.8	0.02	0.00	ND
CT:HARTFORD	50.0	0.12	0.03	ND
FL:JACKSONVILLE	88.8	0.10	0.04	ND
FL:MIAMI	47.1	0.04	0.02	ND
ID:BOISE	77.4	0.04	0.04	ND
ID:IDAHO FALLS	47.0	- 0.06	0.02	ND
IL:CHICAGO	10.4	0.02	0.01	ND
LA:NEW ORLEANS	63.0	0.04	0.03	ND
MN:MINNEAPOLIS	19.7	0.03	0.01	ND
MO:JEFFERSON CITY	130.0	0.16	0.06	ND
MS:JACKSON	133.0	0.16	0.06	ND
NC:CHARLOTTE	102.4	0.29	0.06	ND
NC:WILMINGTON	90.0	0.01	0.03	ND
NJ:TRENTON	61.5	0.10	0.03	ND
NY:ALBANY	25.0	0.02	0.01	ND
NY:NEW YORK CITY	36.2	0.05	0.02	ND
NY:NIAGARA FALLS	58.0	0.12	0.03	ND
NY:SYRACUSE	8.0	0.00	0.00	ND
NY:YAPHANK	100.0	0.06	0.04	ND
OH:PAINESVILLE	79.0	0.18	0.04	ND
OH:TOLEDO	34.0	0.02	0.01	ND
OK:OKLAHOMA CITY	31.0	0.01	0.01	ND
OR:PORTLAND	147.2	0.08	0.06	ND
PA:HARRISBURG	92.4	0.05	0.04	ND
PA:MIDDLETOWN	16.0	0.00	0.01	ND
SC:COLUMBIA	111.0	0.26	0.07	ND

Table 7 (continued)

Gross Beta Concentrations in Precipitation

March 1989

Location	Depth (mm)	Act. $\pm 2\sigma$ (nCi/m^2)		Specific Gamma Activity
TN:KNOXVILLE	98.2	0.06	0.04	ND
TN:NASHVILLE	142.3	0.17	0.07	ND
TX:EL PASO	12.0	0.04	0.01	ND
UT:SALT LAKE CITY	20.2	0.09	0.01	ND
VA:LYNCHBURG	64.4	0.19	0.04	ND
WA:OLYMPIA	232.0	0.10	0.09	ND
WI:MADISON	31.2	0.02	0.01	ND
WV:CHARLESTON	95.0	0.23	0.05	ND

σ = Sigma Counting Error.
NA = Not Analyzed.
ND = No Gamma Activity Detectable.

Table 8

Precipitation
Tritium Concentrations

January - March 1989

Location	January 1989 nCi/l	±2σ	February 1989 nCi/l	±2σ	March 1989 nCi/l	±2σ
AL:MONTGOMERY	0.1	0.2	0.1	0.2	0.2	0.2
AR:LITTLE ROCK	0.2	0.2	0.1	0.2	0.1	0.2
AZ:PHOENIX	0.1	0.2	NS		0.2	0.2
CA:BERKELEY	0.2	0.2	0.1	0.2	0.2	0.2
CO:DENVER	0.1	0.2	NS		0.2	0.2
CT:HARTFORD	0.1	0.2	0.2	0.2	0.1	0.2
FL:JACKSONVILLE	0.1	0.2	0.2	0.2	0.1	0.2
FL:MIAMI	0.1	0.2	0.1	0.2	0.2	0.2
ID:BOISE	0.1	0.2	0.2	0.2	0.2	0.2
ID:IDAHO FALLS	NS		0.1	0.2	0.2	0.2
IL:CHICAGO	NS		0.2	0.2	0.2	0.2
LA:NEW ORLEANS	0.2	0.2	NS		0.2	0.2
MA:LAWRENCE	0.1	0.2	0.1	0.2	NS	
MN:MINNEAPOLIS	0.2	0.2	0.2	0.2	0.1	0.2
MO:JEFFERSON CITY	0.3	0.2	0.2	0.2	0.2	0.2
MS:JACKSON	0.1	0.2	0.1	0.2	0.3	0.2
NC:CHARLOTTE	0.1	0.2	0.1	0.2	0.1	0.2
NC:WILMINGTON	0.1	0.2	0.2	0.2	0.1	0.2
ND:BISMARCK	0.2	0.2	NS		NS	
NJ:TRENTON	0.1	0.2	0.1	0.2	0.2	0.2
NV:LAS VEGAS	0.1	0.2	NS		NS	
NY:ALBANY	0.2	0.2	NS		0.2	0.2
NY:NEW YORK CITY	0.1	0.2	0.1	0.2	0.3	0.2
NY:NIAGARA FALLS	0.2	0.2	0.3	0.2	0.3	0.2
NY:SYRACUSE	NS		NS		0.1	0.2
NY:YAPHANK	0.2	0.2	0.2	0.2	0.1	0.2
OH:PAINESVILLE	0.1	0.2	0.2	0.2	0.2	0.2
OH:TOLEDO	NS		NS		0.1	0.2
OK:OKLAHOMA CITY	0.2	0.2	0.1	0.2	0.1	0.2
OR:PORTLAND	0.2	0.2	0.2	0.2	0.2	0.2
PA:HARRISBURG	0.1	0.2	0.1	0.2	0.1	0.2
PA:MIDDLETOWN	0.3	0.2	0.1	0.2	0.2	0.2
SC:BARNWELL	NS		0.3	0.2	NS	
SC:COLUMBIA	0.2	0.2	0.6	0.2	0.3	0.2
TN:KNOXVILLE	0.2	0.2	0.2	0.2	0.3	0.2
TN:NASHVILLE	0.1	0.2	0.2	0.2	0.2	0.2
TX:AUSTIN	0.3	0.2	NS		NS	

Table 8 (continued)

Precipitation
Tritium Concentrations
January - March 1989

Location	January 1989 nCi/l	±2σ	February 1989 nCi/l	±2σ	March 1989 nCi/l	±2σ
TX:EL PASO	NS		0.1	0.2	0.2	0.2
UT:SALT LAKE CITY	0.2	0.2	0.2	0.2	0.2	0.2
VA:LYNCHBURG	0.2	0.2	0.3	0.2	0.1	0.2
WA:OLYMPIA	0.1	0.2	0.1	0.2	0.1	0.2
WI:MADISON	0.1	0.2	0.2	0.2	0.1	0.2
WV:CHARLESTON	0.1	0.2	0.2	0.2	0.1	0.2

σ = Sigma Counting Error.
NS = No Sample.

Plutonium and Uranium in Airborne Particulates and Precipitation

Environmental radiation levels of plutonium and uranium are determined by the analysis of semiannually composited samples (air filters) collected from the continuously operating airborne particulate samplers.

Concentration of the specific isotopes of plutonium–238, –239, and –240 and uranium–234, –235, and –238 are determined by alpha spectroscopy following chemical separation. The volume of air represented by the semiannual composite ranges from 25,000 to 40,000 cubic meters.

Plutonium and uranium results are published when they become available.

Table 9 contains the plutonium and uranium in precipitation data for March - May 1988. Values are based upon composites of the March, April, and May samples. Samples from these three months only are analyzed annually because, due to the spring rains, they usually contain the year's highest concentrations of plutonium and uranium.

Table 9

Plutonium and Uranium Analyses
Selected Precipitation Composite Samples

March - May 1988

Location	^{238}Pu		$^{239-240}Pu$		^{234}U		^{235}U		^{238}U	
	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
AL:MONTGOMERY	0.008	0.008	0.001	0.003	0.029	0.017	0.008	0.007	0.018	0.011
AR:LITTLE ROCK	0.004	0.012	0.001	0.009	0.043	0.016	0.000	0.008	0.023	0.012
AZ:PHOENIX	0.015	0.018	-0.001	0.006	0.042	0.023	0.002	0.005	0.041	0.021
CA:BERKELEY	0.028	0.018	-0.010	0.012	0.024	0.012	0.000	0.006	0.018	0.010
CO:DENVER	0.006	0.009	-0.001	0.006	0.031	0.016	-0.003	0.006	0.031	0.015
CT:HARTFORD	0.025	0.013	0.004	0.006	0.018	0.015	0.002	0.004	0.012	0.011
DE:WILMINGTON	0.010	0.016	0.002	0.007	0.013	0.010	0.000	0.004	0.005	0.007
FL:JACKSONVILLE	0.000	0.010	0.000	0.006	0.023	0.014	0.003	0.004	0.012	0.009
FL:MIAMI	0.002	0.011	-0.001	0.005	0.016	0.014	0.006	0.005	0.021	0.011
ID:BOISE	0.014	0.013	0.003	0.008	0.011	0.013	0.002	0.008	0.018	0.013
ID:IDAHO FALLS	0.010	0.014	0.003	0.008	0.186	0.037	0.005	0.006	0.129	0.030
IL:CHICAGO	0.002	0.009	0.001	0.005	0.062	0.027	0.000	0.000	0.022	0.019
LA:NEW ORLEANS	0.020	0.021	0.005	0.006	0.039	0.018	0.002	0.004	0.023	0.013
MA:LAWRENCE	0.007	0.016	0.007	0.008	0.028	0.013	0.005	0.005	0.024	0.012
ME:AUGUSTA	-.003	0.010	0.002	0.005	0.045	0.016	0.008	0.007	0.015	0.009
MI:LANSING	0.001	0.011	0.001	0.005	0.054	0.020	0.003	0.006	0.051	0.018
MN:MINNEAPOLIS	-.030	0.216	0.009	0.077	0.025	0.015	0.005	0.006	0.016	0.012
MO:JEFFERSON CITY	0.021	0.018	0.001	0.007	0.028	0.017	-0.002	0.003	0.018	0.011
MS:JACKSON	0.007	0.010	0.002	0.003	0.029	0.016	0.000	0.005	0.039	0.018
NC:CHARLOTTE	0.028	0.015	0.003	0.008	0.028	0.014	-0.004	0.005	0.010	0.008
NC:WILMINGTON	0.039	0.028	-0.006	0.015	0.015	0.014	0.009	0.007	0.009	0.007
ND:BISMARCK	0.010	0.013	-0.001	0.003	0.046	0.019	0.000	0.000	0.038	0.017
NH:CONCORD	0.008	0.012	0.003	0.007	0.015	0.010	0.005	0.008	0.017	0.011
NJ:TRENTON	0.018	0.013	0.003	0.005	0.023	0.013	0.000	0.000	0.012	0.009
NM:SANTA FE	0.016	0.013	0.001	0.004	0.027	0.013	0.000	0.000	0.012	0.008
NV:LAS VEGAS	0.007	0.016	0.012	0.013	0.224	0.049	0.002	0.009	0.110	0.032
NY:ALBANY	0.010	0.010	0.004	0.005	0.024	0.013	0.002	0.004	0.022	0.011
NY:NEW YORK CITY	0.007	0.010	0.001	0.003	0.032	0.015	0.000	0.008	0.019	0.011
NY:NIAGARA FALLS	0.000	0.013	-0.006	0.006	0.021	0.012	0.005	0.005	0.023	0.012
NY:SYRACUSE	0.017	0.011	0.001	0.005	0.015	0.010	0.003	0.005	0.017	0.009
NY:YAPHANK	-.006	0.010	0.002	0.005	0.008	0.014	0.007	0.006	0.025	0.011
OH:COLUMBUS	-.003	0.028	0.013	0.016	0.040	0.018	-0.002	0.006	0.018	0.012
OH:PAINESVILLE	0.014	0.013	0.002	0.003	0.022	0.015	0.000	0.000	0.029	0.013
OH:TOLEDO	0.017	0.014	0.002	0.003	0.012	0.012	-0.001	0.003	0.029	0.013
OR:PORTLAND	0.019	0.012	-0.001	0.003	0.016	0.011	0.007	0.008	0.012	0.009
PA:HARRISBURG	0.023	0.016	-0.004	0.007	0.024	0.014	0.003	0.004	0.028	0.014
PA:MIDDLETOWN	0.007	0.011	-0.001	0.003	0.026	0.013	0.004	0.007	0.016	0.011

Table 9 (continued)

Plutonium and Uranium Analyses
Selected Precipitation Composite Samples

March - May 1988

Location	^{238}Pu pCi/l	±2σ	$^{239-240}Pu$ pCi/l	±2σ	^{234}U pCi/l	±2σ	^{235}U pCi/l	±2σ	^{238}U pCi/l	±2σ
PA:PHILADELPHIA	0.004	0.013	0.000	0.005	0.023	0.015	-0.001	0.005	0.023	0.013
PA:PITTSBURGH	0.018	0.011	0.006	0.006	0.037	0.017	0.005	0.005	0.013	0.010
RI:PROVIDENCE	0.010	0.011	0.001	0.004	0.032	0.014	0.006	0.006	0.028	0.013
SC:BARNWELL	0.009	0.009	0.000	0.004	0.047	0.021	-0.001	0.008	0.025	0.015
SC:COLUMBIA	0.012	0.014	0.000	0.007	0.047	0.018	0.008	0.007	0.012	0.009
TN:KNOXVILLE	0.008	0.017	0.002	0.009	0.038	0.018	0.003	0.007	0.023	0.011
TN:NASHVILLE	0.002	0.008	0.003	0.004	0.016	0.011	0.000	0.004	0.019	0.012
TX:AUSTIN	0.004	0.009	0.002	0.007	0.047	0.020	0.006	0.009	0.033	0.017
VA:LYNCHBURG	0.011	0.012	0.001	0.006	NA		NA		NA	
WA:OLYMPIA	0.000	0.011	0.002	0.007	0.035	0.023	-0.006	0.007	0.023	0.016
WI:MADISON	0.013	0.016	-0.001	0.005	0.060	0.023	0.004	0.005	0.026	0.016
WV:CHARLESTON	0.003	0.008	0.001	0.003	0.027	0.012	0.009	0.007	0.017	0.010

σ = Sigma Counting Error.
NA = No Analysis.

Krypton–85

Krypton–85 is a long–lived noble gas with a half–life of 10.8 years. It is released into the atmosphere by nuclear reactor operations, fuel reprocessing, weapons tests, and research and defense related activities. Krypton–85 also occurs naturally in minor quantities primarily from the neutron capture of stable krypton–84 as well as spontaneous fission and neutron–induced fission of uranium. Krypton–85 in the atmosphere has been monitored to identify and establish baseline levels and long–term trends.

Krypton–85 analysis began in January 1973 with sample collections and analyses being performed for 12 sampling locations. These locations were selected to provide atmospheric coverage of the United States with considerations being given to the proximity to fuel reprocessing plants, nuclear reactors, and wide geographic coverage.

Dry compressed air samples, collected at each location, are purchased from commercial air suppliers and shipped to the EERF where the krypton–85 is cryogenically separated and counted in a liquid scintillation system.

The last Kr–85 results were for 1976, 1977, and 1979. They were published in *Environmental Radiation Data: Report 30.*

ENVIRONMENTAL RADIATION AMBIENT MONITORING SYSTEM (ERAMS)

Section II. Water Program

The ERAMS water program provides data on ambient radiation levels in the nation's rivers, streams, and drinking water supplies.

Surface Water

Quarterly grab samples are taken downstream from operating or future nuclear facilities at 58 stations.

Surface water samples are analyzed for tritium quarterly and specific gamma activity annually. Tritium is a primary radioactive poliutant from nuclear power plants and weapons production activities.

Tritium concentrations are determined by liquid scintillation counting of distilled samples. Gamma scans are performed annually to determine levels of gamma emitting radionuclides.

Table 10 contains the data for tritium concentrations for January - March 1989. Table 11 contains the surface water annual gamma results for April 1988.

Table 10

Surface Water
Tritium Concentrations

January - March 1989

Location	Source	Date Collected	nCi/l	±2σ
AL:DECATUR	TENNESSEE RIVER	01/04/89	0.1	0.2
AL:DOTHAN	CHATTAHOOCHEE RIVER	01/11/89	0.2	0.2
AL:SCOTTSBORO	TENNESSEE RIVER	01/04/89	0.1	0.2
AR:LITTLE ROCK	ARKANSAS RIVER	01/03/89	0.2	0.2
CA:EUREKA	HUMBOLDT BAY	01/17/89	0.2	0.2
CA:SAN ONOFRE	PACIFIC OCEAN	02/16/89	0.2	0.2
CO:PLATTEVILLE	SOUTH PLATTE RIVER	01/04/89	0.2	0.2
CT:EAST HADDAM	CONNECTICUT RIVER	01/20/89	0.2	0.2
CT:WATERFORD	LONG ISLAND SOUND	01/20/89	0.1	0.2
FL:CRYSTAL RIVER	GULF OF MEXICO	01/17/89	0.1	0.2
FL:FT. PIERCE	ATLANTIC OCEAN	01/11/89	0.1	0.2
FL:HOMESTEAD	BISCAYNE BAY	01/24/89	0.3	0.2
GA:BAXLEY	ALTAMAHA RIVER	01/11/89	0.2	0.2
IA:CEDAR RAPIDS	CEDAR RIVER	01/09/89	0.1	0.2
ID:BUHL	SNAKE RIVER	01/19/89	0.2	0.2
IL:E. MOLINE	MISSISSIPPI RIVER	01/09/89	0.2	0.2
IL:MORRIS	ILLINOIS RIVER	01/08/89	0.3	0.2
IL:ZION	LAKE MICHIGAN	03/31/89	0.2	0.2
KS:LEROY	NEOSHO RIVER	02/18/89	0.1	0.2
LA:NEW ORLEANS	MISSISSIPPI RIVER	01/11/89	0.2	0.2
MA:PLYMOUTH	CAPE COD BAY	01/05/89	0.2	0.2
MD:CONOWINGO	SUSQUEHANNA RIVER	01/24/89	0.2	0.2
MD:LUSBY	CHESAPEAKE BAY	01/10/89	0.2	0.2
ME:WISCASSET	MONTSEWAY BAY	01/10/89	0.2	0.2
MI:BRIDGMAN	LAKE MICHIGAN	01/15/89	0.3	0.2
MI:CHARLEVOIX	LAKE MICHIGAN	01/06/89	0.1	0.2
MI:MONROE	LAKE ERIE	01/12/89	0.2	0.2
MI:SOUTH HAVEN	LAKE MICHIGAN	01/15/89	0.2	0.2
MN:MONTICELLO	MISSISSIPPI RIVER	01/13/89	0.1	0.2
MN:RED WING	MISSISSIPPI RIVER	01/17/89	0.2	0.2
MS:PORT GIBSON	MISSISSIPPI RIVER	01/17/89	0.1	0.2
NC:CHARLOTTE	CATAWBA RIVER	01/10/89	0.8	0.2
NC:SOUTHPORT	ATLANTIC OCEAN	01/06/89	0.2	0.2
NE:RULO	MISSOURI RIVER	01/17/89	0.2	0.2
NJ:BAYSIDE	DELAWARE RIVER	01/10/89	0.2	0.2
NJ:OYSTER CREEK	OYSTER CREEK	01/19/89	0.2	0.2
NV:BOULDER CITY	COLORADO RIVER	01/10/89	0.3	0.2

Table 10 (continued)

Surface Water
Tritium Concentrations

January - March 1989

Location	Source	Date Collected	nCi/l	$\pm 2\sigma$
NY:CHELSEA	HUDSON RIVER	01/04/89	0.2	0.2
NY:OSSINING	HUDSON RIVER	01/18/89	0.4	0.2
NY:OSWEGO	LAKE ONTARIO	01/31/89	0.3	0.2
OH:TOLEDO	LAKE ERIE	01/04/89	0.1	0.2
OR:BRADWOOD	COLUMBIA RIVER	01/09/89	0.1	0.2
PA:DANVILLE	SUSQUEHANNA RIVER	01/25/89	0.2	0.2
SC:ALLENDALE	SAVANNAH RIVER	01/31/89	4.6	0.2
SC:BROAD RIVER	BROAD RIVER	01/03/89	0.4	0.2
SC:HARTSVILLE	LAKE ROBINSON	01/06/89	1.1	0.2
TN:KINGSTON	CLINCH RIVER	01/09/89	1.5	0.2
TX:EL PASO	RIO GRANDE	02/03/89	0.2	0.2
TX:MATAGORDA	COLORADO RIVER	01/18/89	0.1	0.2
VA:DOSWELL	NORTH ANNA RIVER	01/12/89	5.5	0.2
VA:NEWPORT NEWS	JAMES RIVER	01/18/89	0.1	0.2
WA:NORTHPORT	COLUMBIA RIVER	01/08/89	0.2	0.2
WA:RICHLAND	COLUMBIA RIVER	01/26/89	0.1	0.2
WI:TWO CREEKS	LAKE MICHIGAN	01/16/89	0.3	0.2
WI:VICTORY	MISSISSIPPI RIVER	01/10/89	0.3	0.2
WV:WHEELING	OHIO RIVER	03/16/89	0.2	0.2

σ = Sigma Counting Error.

Table 11

Surface Water
Annual Gamma Analysis

April 1988

Location	Source	Date Collected	Gamma pCi/l $\pm 2\sigma$
AL:DECATUR	TENNESSEE RIVER	04/05/88	ND
AL:DOTHAN	CHATTAHOOCHEE RIVER	04/12/88	ND
AL:SCOTTSBORO	TENNESSEE RIVER	04/07/88	ND
AR:LITTLE ROCK	ARKANSAS RIVER	04/06/88	ND
CA:DIABLO CANYON	PACIFIC OCEAN	*03/30/88	ND
CA:EUREKA	HUMBOLDT BAY	*03/31/88	^{40}K: 261 ±32 %
CA:SAN ONOFRE	PACIFIC OCEAN	*05/20/88	^{40}K: 294 ±29 %
CA:SAN ONOFRE	PACIFIC OCEAN	*03/28/88	^{40}K: 310 ±63 %
CO:PLATTEVILLE	SOUTH PLATTE RIVER	04/04/88	ND
CT:EAST HADDAM	CONNECTICUT RIVER	*06/09/88	ND
CT:WATERFORD	LONG ISLAND SOUND	*06/09/88	^{40}K: 332 ±26 %
FL:CRYSTAL RIVER	GULF OF MEXICO	*03/28/88	ND
FL:FT. PIERCE	ATLANTIC OCEAN	*03/29/88	ND
FL:HOMESTEAD	BISCAYNE BAY	04/11/88	ND
GA:BAXLEY	ALTAMAHA RIVER	04/05/88	ND
IA:CEDAR RAPIDS	CEDAR RIVER	*03/22/88	ND
ID:BUHL	SNAKE RIVER	04/21/88	ND
IL:E. MOLINE	MISSISSIPPI RIVER	04/06/88	ND
IL:MORRIS	ILLINOIS RIVER	04/24/88	ND
IL:ZION	LAKE MICHIGAN	*05/15/88	ND
KS:LEROY	NEOSHO RIVER	*03/29/88	ND
LA:NEW ORLEANS	MISSISSIPPI RIVER	04/11/88	ND
MA:PLYMOUTH	CAPE COD BAY	04/06/88	ND
MA:ROWE	DEERFIELD RIVER	*05/15/88	ND
MD:CONOWINGO	SUSQUEHANNA RIVER	04/26/88	ND
MD:LUSBY	CHESAPEAKE BAY	*03/22/88	^{40}K: 122 ±66 %
ME:WISCASSET	MONTSEWAY BAY	04/05/88	^{40}K: 199 ±42 %
MI:BRIDGMAN	LAKE MICHIGAN	04/06/88	ND
MI:CHARLEVOIX	LAKE MICHIGAN	*03/26/88	ND
MI:MONROE	LAKE ERIE	*03/28/88	ND
MI:SO. HAVEN	LAKE MICHIGAN	04/07/88	ND
MN:MONTICELLO	MISSISSIPPI RIVER	04/05/88	ND
MN:RED WING	MISSISSIPPI RIVER	04/14/88	ND
MS:PORT GIBSON	MISSISSIPPI RIVER	04/14/88	ND
NC:CHARLOTTE	CATAWBA RIVER	04/06/88	ND
NC:SOUTHPORT	ATLANTIC OCEAN	04/05/88	^{40}K: 245 ±35 %
NE:RULO	MISSOURI RIVER	04/07/88	ND

Table 11 (continued)

Surface Water
Annual Gamma Analysis

April 1988

Location	Source	Date Collected	Gamma pCi/l $\pm 2\sigma$
NJ:BAYSIDE	DELAWARE RIVER	*05/10/88	^{40}K: 147 ±56 %
NJ:OYSTER CREEK	OYSTER CREEK	04/21/88	^{40}K: 231 ±37 %
NV:BOULDER CITY	COLORADO RIVER	04/04/88	ND
NY:CHELSEA	HUDSON RIVER	*03/22/88	ND
NY:OSSINING	HUDSON RIVER	04/27/88	ND
NY:OSWEGO	LAKE ONTARIO	04/28/88	ND
OH:TOLEDO	LAKE ERIE	*03/21/88	ND
OR:BRADWOOD	COLUMBIA RIVER	04/21/88	ND
PA:DANVILLE	SUSQUEHANNA RIVER	04/27/88	ND
SC:ALLENDALE	SAVANNAH RIVER	04/28/88	ND
SC:BROAD RIVER	BROAD RIVER	04/20/88	ND
SC:HARTSVILLE	LAKE ROBINSON	04/19/88	ND
TN:DAISY	TENNESSEE RIVER	04/05/88	ND
TN:KINGSTON	CLINCH RIVER	04/05/88	ND
TX:EL PASO	RIO GRANDE	*03/21/88	ND
TX:MATAGORDA	COLORADO RIVER	04/14/88	^{40}K: 92 ±87 %
VA:DOSWELL	NORTH ANNA RIVER	04/14/88	ND
VA:NEWPORT NEWS	JAMES RIVER	04/12/88	^{40}K: 202 ±41 %
WA:NORTHPORT	COLUMBIA RIVER	*05/18/88	ND
WA:RICHLAND	COLUMBIA RIVER	*05/10/88	^{214}Bi: 58 ±76 %
WI:TWO CREEKS	LAKE MICHIGAN	04/04/88	ND
WI:VICTORY	MISSISSIPPI RIVER	04/11/88	ND
WV:WHEELING	OHIO RIVER	*06/09/88	ND

σ = Sigma Counting Error.
* = Sample Not Available in April.
ND = No Gamma Activity Detectable.

Drinking Water

This program monitors ambient radiation levels in drinking water at 78 sites. These data serve to assess trends and anomalies in concentrations, and to compare with standards set forth in the EPA "National Interim Primary Drinking Water Regulations." These regulations provide for approval of supplies when the combined radium–226 and radium–228 levels do not exceed 5 pCi/l, when the gross alpha (excluding radon and uranium) levels do not exceed 15 pCi/l, when tritium levels do not exceed 20,000 pCi/l, when the strontium–90 levels do not exceed 8 pCi/l, and when the gross beta levels do not exceed 50 pCi/l.

Grab samples are taken at the 78 sites which are either major population centers or selected nuclear facility environs.

The analyses include (a) tritium on a quarterly basis; (b) gross alpha, gross beta, strontium–90, and gamma on annual composites; (c) radium–226 if the gross alpha exceeds 2 pCi/l and radium–228 if the radium–226 falls between 3 and 5 pCi/l; (d) specific iodine–131 on one quarterly sample per year for each station; and (e) an annual composite for plutonium–238, –239, and –240 and uranium–234, –235, and –238 for stations that demonstrate gross alpha levels greater than 2 pCi/l.

Tritium analyses are performed by scintillation counting of the distilled samples. Gross beta and alpha are determined by evaporating an aliquot on a stainless steel planchet for counting. Radium–226 is determined by the standard emanation technique. Strontium–90 is determined by beta counting a strontium carbonate precipitate isolated by ion exchange.

Table 12 contains the data in drinking water for January - March 1989. Table 13 contains the I-131 in drinking water results for January - December 1988.

Table 12

Drinking Water
Tritium Concentrations

January - March 1989

Location	Date Collected	nCi/l	$\pm 2\sigma$
AK:FAIRBANKS	01/20/89	0.2	0.2
AL:DOTHAN	01/11/89	0.2	0.2
AL:MONTGOMERY	01/09/89	0.1	0.2
AL:MUSCLE SHOALS	01/04/89	0.2	0.2
AL:SCOTTSBORO	01/04/89	0.2	0.2
AR:LITTLE ROCK	01/06/89	0.2	0.2
CA:BERKELEY	01/04/89	0.1	0.2
CA:LOS ANGELES	01/09/89	0.1	0.2
CO:DENVER	01/04/89	0.2	0.2
CO:PLATTEVILLE	01/04/89	0.2	0.2
CT:HARTFORD	01/04/89	0.2	0.2
DC:WASHINGTON	01/06/89	0.2	0.2
DE:DOVER	01/03/89	0.1	0.2
FL:MIAMI	01/23/89	0.2	0.2
FL:TAMPA	01/10/89	0.3	0.2
GA:BAXLEY	01/11/89	0.1	0.2
GA:SAVANNAH	03/14/89	0.1	0.2
HI:HONOLULU	01/17/89	0.2	0.2
IA:CEDAR RAPIDS	01/03/89	0.2	0.2
ID:BOISE	01/04/89	0.1	0.2
ID:IDAHO FALLS	01/19/89	0.1	0.2
IL:CHICAGO	01/02/89	0.1	0.2
IL:MORRIS	01/06/89	0.1	0.2
KS:TOPEKA	01/03/89	0.2	0.2
LA:NEW ORLEANS	01/05/89	0.1	0.2
MA:LAWRENCE	01/11/89	0.1	0.2
MD:BALTIMORE	02/03/89	0.2	0.2
MD:CONOWINGO	01/24/89	0.2	0.2
ME:AUGUSTA	01/17/89	0.2	0.2
MI:DETROIT	01/10/89	0.2	0.2
MI:GRAND RAPIDS	01/12/89	0.2	0.2
MN:MINNEAPOLIS	01/10/89	0.2	0.2
MN:RED WING	01/17/89	0.1	0.2
MO:JEFFERSON CITY	01/05/89	0.1	0.2
MS:JACKSON	01/17/89	0.1	0.2

Table 12 (continued)

Drinking Water
Tritium Concentrations
January - March 1989

Location	Date Collected	nCi/l	±2σ
MS:PORT GIBSON	01/17/89	0.1	0.2
MT:HELENA	01/04/89	0.3	0.2
NC:CHARLOTTE	01/10/89	0.9	0.2
NC:WILMINGTON	02/03/89	0.2	0.2
ND:BISMARCK	01/03/89	0.1	0.2
NE:LINCOLN	01/04/89	0.2	0.2
NH:CONCORD	01/03/89	0.1	0.2
NJ:TRENTON	01/06/89	0.2	0.2
NJ:WARETOWN	01/19/89	0.1	0.2
NV:LAS VEGAS	01/06/89	0.2	0.2
NY:ALBANY	01/03/89	0.1	0.2
NY:NEW YORK CITY	01/04/89	0.1	0.2
NY:NIAGARA FALLS	01/04/89	0.2	0.2
NY:SYRACUSE	02/28/89	0.2	0.2
OH:COLUMBUS	01/24/89	0.2	0.2
OH:EAST LIVERPOOL	02/01/89	0.2	0.2
OH:PAINESVILLE	01/04/89	0.2	0.2
OH:TOLEDO	01/04/89	0.1	0.2
OK:OKLAHOMA CITY	01/17/89	0.2	0.2
OR:PORTLAND	01/10/89	0.2	0.2
PA:COLUMBIA	01/05/89	0.3	0.2
PA:HARRISBURG	01/05/89	0.1	0.2
PA:PITTSBURGH	02/01/89	0.2	0.2
PC:CRISTOBAL	01/03/89	0.1	0.2
RI:PROVIDENCE	01/05/89	0.1	0.2
SC:BARNWELL	02/09/89	0.2	0.2
SC:COLUMBIA	01/04/89	0.3	0.2
SC:HARTSVILLE	01/30/89	0.1	0.2
SC:JENKINSVILLE	01/20/89	0.2	0.2
SC:SENECA	01/24/89	0.1	0.2
TN:CHATTANOOGA	01/31/89	0.3	0.2
TN:KNOXVILLE	01/03/89	0.1	0.2
TX:AUSTIN	02/21/89	0.1	0.2
VA:DOSWELL	01/13/89	0.1	0.2
VA:LYNCHBURG	01/06/89	0.1	0.2

Table 12 (continued)

Drinking Water
Tritium Concentrations
January - March 1989

Location	Date Collected	nCi/l	$\pm 2\sigma$
VA:VIRGINIA BEACH	01/30/89	0.1	0.2
VI:ST. THOMAS	01/19/89	0.1	0.2
WA:RICHLAND	01/26/89	0.1	0.2
WA:SEATTLE	01/04/89	0.1	0.2
WI:GENOA CITY	01/09/89	0.2	0.2
WI:MADISON	01/05/89	0.2	0.2

σ = Sigma Counting Error.

Table 13
Iodine-131 in Drinking Water Concentrations
January - December 1988

Location	Date Collected	pCi/l	$\pm 2\sigma$
AL:DOTHAN	04/13/88	0.1	0.1
AL:MONTGOMERY	04/04/88	0.0	0.1
AL:MUSCLE SHOALS	10/05/88	-0.1	0.1
AL:SCOTTSBORO	10/07/88	-0.2	0.1
AR:LITTLE ROCK	04/06/88	0.1	0.1
CA:BERKELEY	10/05/88	-0.5	0.3
CA:LOS ANGELES	10/05/88	-0.1	0.1
CO:DENVER	04/05/88	-0.1	0.1
CO:PLATTEVILLE	07/05/88	0.0	0.1
CT:HARTFORD	03/28/88	0.0	0.1
DE:DOVER	09/28/88	-0.3	0.1
FL:MIAMI	01/04/88	-0.1	0.1
GA:BAXLEY	04/05/88	0.0	0.1
GA:SAVANNAH	07/22/88	0.1	0.1
HI:HONOLULU	01/05/88	-0.3	0.1
IA:CEDAR RAPIDS	07/05/88	0.1	0.1
ID:BOISE	01/13/88	0.2	0.1
ID:IDAHO FALLS	07/06/88	-0.4	0.1
IL:MORRIS	04/11/88	-0.1	0.1
IL:W. CHICAGO	01/04/88	0.0	0.1
KS:TOPEKA	01/04/88	0.0	0.1
LA:NEW ORLEANS	01/06/88	-0.2	0.1
MA:LAWRENCE	04/20/88	0.0	0.1
MD:CONOWINGO	01/12/88	0.1	0.1
ME:AUGUSTA	05/06/88	0.1	0.1
MI:DETROIT	07/11/88	0.1	0.1
MI:GRAND RAPIDS	03/25/88	0.1	0.1
MN:MINNEAPOLIS	04/05/88	0.2	0.1
MN:RED WING	04/14/88	-0.1	0.1
MS:JACKSON	04/14/88	0.1	0.1
MS:PORT GIBSON	04/14/88	0.0	0.1
MT:HELENA	04/04/88	0.1	0.1
NC:CHARLOTTE	01/06/88	-0.4	0.1
ND:BISMARCK	01/04/88	0.2	0.1
NE:LINCOLN	01/07/88	-0.1	0.1
NH:CONCORD	10/03/88	-0.4	0.1
NJ:TRENTON	10/12/88	0.3	0.1

Table 13 (continued)

Iodine-131 in Drinking Water Concentrations

January - December 1988

Location	Date Collected	pCi/l	$\pm 2\sigma$
NJ:WARETOWN	05/12/88	0.1	0.1
NV:LAS VEGAS	01/07/88	-0.3	0.2
NY:ALBANY	04/11/88	0.1	0.1
NY:NEW YORK CITY	04/06/88	-0.1	0.1
NY:NIAGARA FALLS	01/04/88	0.0	0.1
NY:SYRACUSE	12/08/88	0.0	0.1
OH:CINCINNATI	01/07/88	-0.2	0.1
OH:COLUMBUS	04/06/88	0.0	0.1
OH:EAST LIVERPOOL	04/12/88	0.4	0.1
OH:PAINESVILLE	01/04/88	0.1	0.1
OH:TOLEDO	01/01/88	0.1	0.1
OK:OKLAHOMA CITY	01/05/88	-0.2	0.1
OR:PORTLAND	07/15/88	0.0	0.1
PA:COLUMBIA	01/14/88	0.3	0.1
PA:HARRISBURG	01/11/88	-0.2	0.1
PC:CRISTOBAL	10/11/88	-0.1	0.1
RI:PROVIDENCE	01/13/88	0.1	0.1
SC:BARNWELL	04/14/88	0.0	0.1
SC:COLUMBIA	01/04/88	0.0	0.1
SC:HARTSVILLE	04/19/88	0.1	0.1
SC:JENKINSVILLE	04/18/88	0.0	0.1
SC:SENECA	07/13/88	0.1	0.1
TN:CHATTANOOGA	09/28/88	0.4	0.1
TN:KNOXVILLE	10/03/88	-0.4	0.1
TX:AUSTIN	11/08/88	-0.3	0.1
VA:DOSWELL	01/06/88	-0.1	0.1
VA:LYNCHBURG	01/04/88	-0.4	0.1
VA:VIRGINIA BEACH	10/26/88	-0.1	0.2
WA:RICHLAND	05/10/88	-0.1	0.1
WA:SEATTLE	04/07/88	0.3	0.1
WI:GENOA CITY	01/11/88	0.0	0.0
WI:MADISON	01/06/88	0.2	0.1

σ = Sigma Counting Error.

ENVIRONMENTAL RADIATION AMBIENT MONITORING SYSTEM (ERAMS)

Section III. External Gamma Ambient Monitoring Program

The external gamma monitoring program, which began in October 1978, provides a continuous measurement of ambient gamma exposure rates, including cosmic, at selected sites throughout the continental United States. Data from this program are used to evaluate fluctuations in natural background due to variations in environmental conditions and to provide a means of monitoring any significant increases in ambient gamma levels. The program consists of approximately 22 sites representing wide geographic coverage throughout the country.[1] Although exposure measurements at these few sites are not totally representative of nationwide exposures, they do indicate national trends.

The monitoring program utilizes CaF_2:Mn thermoluminescent dosimeters (TLD's). These dosimeters are commercially available glass-bulb type dosimeters with energy compensating shields. A group of three TLD's is located at each station or site. Dosimeters are annealed by the station operator prior to positioning in the field. The dosimeters are returned to EERF for readout approximately every three months. Several dosimeters are annealed by the station operator as controls and returned with the exposed field dosimeters to correct for any exposures accumulated during shipment.

Table 14 contains the data for environmental gamma ambient monitoring program January - March 1989.

[1] Some of these sites may not return dosimeters each period and consequently the number of sites listed may vary slightly.

Table 14

Environmental Gamma Ambient Monitoring Program

January - March 1989

Location	Date Range	Integrated Exposure mR	Exposure Rate μR/hr	±2σ
AL:MONTGOMERY	01/09/89-04/06/89	18.8	9.0	69.9
CA:BERKELEY	01/13/89-04/04/89	14.9	7.7	9.9
CO:DENVER	01/10/89-05/15/89	46.5	15.5	6.9
FL:ORLANDO	01/06/89-04/04/89	15.4	7.3	8.7
ID:BOISE	01/06/89-04/05/89	27.6	12.9	10.5
IL:CHICAGO	01/12/89-04/06/89	18.6	9.2	7.1
ND:BISMARCK	01/09/89-04/03/89	19.0	9.4	14.9
NJ:TRENTON	01/06/89-04/03/89	28.8	13.8	24.9
NM:SANTA FE	01/20/89-04/07/89	27.5	14.9	6.5
NV:LAS VEGAS	01/06/89-04/04/89	18.0	8.5	7.2
NY:NEW YORK	02/08/89-04/12/89	15.3	10.1	5.8
OR:PORTLAND	01/11/89-04/06/89	18.6	9.1	5.0
PA:HARRISBURG	01/11/89-04/10/89	15.6	7.3	11.7
PA:PITTSBURGH	01/09/89-04/07/89	27.4	13.0	12.9
RI:PROVIDENCE	01/06/89-04/07/89	27.3	12.5	7.6
SC:BARNWELL	01/27/89-04/07/89	19.4	11.7	9.0
SC:COLUMBIA	01/06/89-04/04/89	25.5	12.1	5.9
TN:KNOXVILLE	01/02/89-04/04/89	21.4	9.7	6.2
VA:RICHMOND	01/05/89-04/03/89	18.1	8.6	7.5
VT:MONTPELIER	02/01/89-04/06/89	13.6	8.8	7.4

σ = Sigma Counting Error (in percent).

ENVIRONMENTAL RADIATION AMBIENT MONITORING SYSTEM (ERAMS)

Section IV. Milk Program

Pasteurized Milk

This is a cooperative program with the Dairy and Lipid Products Branch, Milk Sanitation Section, Food and Drug Administration. Milk is a reliable indicator of the general population's intake of radionuclides since it is consumed fresh by a large segment of the population and can contain several of the biologically important radionuclides that result from environmental releases from nuclear activities. A primary function of this program is to obtain reliable monitoring data relative to current radionuclide concentrations and determine any long-term trends.

Monthly samples are collected at 65 sampling sites with one or more located in each state, Puerto Rico, and the Panama Canal Zone. The samples are composited, according to production, from the major milk suppliers representing more than 80 percent of the milk consumed in a given population center.

The samples are analyzed for gamma emitting nuclides, which include iodine–131, barium–140, cesium–137, and potassium. All samples collected in July are analyzed for strontium–89 and strontium–90. Also, for the first month of the three quarters beginning January, April and October, 10 regional composite samples of milk made up from the states within each of EPA's 10 regions are analyzed for strontium–89 and strontium–90.

Iodine–131, barium–140, cesium–137, and potassium are determined by gamma spectral analysis. Strontium–89 and strontium–90 are determined by beta counting a total strontium precipitate that has been chemically separated by ion exchange.

Tables 15–17 contain the concentrations of radionuclides in pasteurized milk for January - March 1989. Table 18 contains the concentrations of strontium-90 and strontium-89 in pasteurized milk EPA Regional Composites for January - March 1989.

Table 15

Concentrations of Radionuclides in Pasteurized Milk

January 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
AL:MONTGOMERY	01/06/89	1.47	0.12	-2	7	-11	8	3	7
AR:LITTLE ROCK	01/10/89	1.59	0.12	-1	7	-5	8	-3	7
AZ:PHOENIX	01/10/89	1.40	0.13	3	9	-11	9	5	7
CA:LOS ANGELES	01/06/89	1.55	0.12	2	7	-4	8	1	7
CA:SACRAMENTO	01/03/89	1.50	0.13	0	9	-5	9	1	7
CA:SAN FRANCISCO	01/05/89	1.48	0.13	5	9	-5	9	10	7
CO:DENVER	01/31/89	1.55	0.13	11	8	1	11	7	8
CT:HARTFORD	01/09/89	1.52	0.12	-1	7	-7	8	-2	7
DC:WASHINGTON	01/04/89	1.67	0.13	5	7	-10	8	3	7
DE:WILMINGTON	01/04/89	1.60	0.12	1	7	-6	8	0	7
FL:TAMPA	01/05/89	1.65	0.13	8	7	-9	8	1	7
GA:ATLANTA	01/09/89	1.36	0.12	11	9	-7	9	5	7
HI:HONOLULU	01/03/89	1.56	0.08	-1	5	-1	6	4	5
IA:DES MOINES	01/04/89	1.34	0.12	4	9	1	9	2	7
ID:IDAHO FALLS	01/10/89	1.29	0.12	0	9	-7	9	7	7
IL:CHICAGO	01/03/89	1.34	0.09	5	6	-4	6	3	5
IN:INDIANAPOLIS	01/03/89	1.18	0.12	6	9	2	9	1	7
KS:WICHITA	01/18/89	1.37	0.08	2	6	-5	6	3	5
KY:LOUISVILLE	01/03/89	1.70	0.13	12	7	2	8	3	7
LA:NEW ORLEANS	01/06/89	1.47	0.08	8	6	-6	6	4	5
MA:BOSTON	01/09/89	1.31	0.08	3	6	-8	6	5	5
MD:BALTIMORE	01/06/89	1.64	0.13	2	7	-7	8	-6	7
MI:DETROIT	01/05/89	1.73	0.13	3	7	-10	8	2	7
MI:GRAND RAPIDS	01/03/89	1.41	0.13	8	9	-8	9	3	7
MN:MINNEAPOLIS	01/07/89	1.36	0.12	1	9	-3	9	5	7
MN:ST. PAUL	01/04/89	1.54	0.12	-1	7	-2	8	-4	7
MO:ST. LOUIS	01/06/89	1.53	0.12	1	7	-9	8	-4	7
MS:JACKSON	01/03/89	1.38	0.12	12	9	-6	9	3	7
MT:HELENA	01/04/89	1.40	0.09	3	6	-8	6	4	5
NC:CHARLOTTE	01/09/89	1.59	0.23	5	14	-5	19	-9	14
ND:MINOT	01/27/89	1.41	0.13	10	9	2	9	9	7
NE:OMAHA	01/05/89	1.54	0.12	2	7	-6	8	2	7
NH:MANCHESTER	01/09/89	1.39	0.13	8	9	-3	9	7	7
NJ:TRENTON	01/04/89	1.57	0.12	2	7	5	8	7	7
NM:ALBUQUERQUE	01/03/89	1.35	0.08	5	6	-2	6	5	5
NV:LAS VEGAS	01/11/89	1.34	0.12	8	9	-5	9	6	7
NY:BUFFALO	01/17/89	1.32	0.12	1	9	-1	9	10	7

Table 15 (continued)

Concentrations of Radionuclides in Pasteurized Milk

January 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
NY:NEW YORK CITY	01/04/89	1.47	0.13	8	9	-2	9	4	7
NY:SYRACUSE	01/03/89	1.35	0.08	4	6	-3	6	7	5
OH:CINCINNATI	01/27/89	1.52	0.23	9	14	12	20	12	15
OH:CLEVELAND	01/10/89	1.68	0.13	3	7	-10	8	0	7
OK:OKLAHOMA CITY	01/24/89	1.36	0.08	3	6	-2	6	2	5
OR:PORTLAND	01/04/89	1.39	0.13	4	9	-5	9	2	7
PA:PHILADELPHIA	01/03/89	1.61	0.09	1	5	-3	6	-4	5
PA:PITTSBURGH	01/03/89	1.61	0.23	10	14	-4	19	3	15
PC:CRISTOBAL	01/26/89	1.40	0.13	7	9	1	9	5	7
PR:SAN JUAN	01/23/89	1.38	0.12	2	9	-1	9	4	7
SC:CHARLESTON	01/19/89	1.30	0.12	15	9	-3	9	5	7
SD:RAPID CITY	01/06/89	1.36	0.12	3	9	-1	9	2	7
TN:CHATTANOOGA	01/03/89	1.64	0.09	4	5	-11	6	2	5
TN:MEMPHIS	01/25/89	1.41	0.13	0	9	1	9	0	7
TX:AUSTIN	01/05/89	1.46	0.13	2	9	-6	9	3	7
TX:FT. WORTH	01/05/89	1.38	0.12	7	9	-3	9	4	7
VT:BURLINGTON	01/06/89	1.41	0.13	4	9	-1	9	2	7
WA:SEATTLE	01/04/89	1.60	0.12	2	7	-20	11	-2	7
WA:SPOKANE	01/10/89	1.56	0.08	4	5	-4	6	-3	5
WI:MILWAUKEE	01/03/89	1.64	0.1[illegible]	4	7	-5	8	0	7
WY:LARAMIE	01/06/89	1.39	[illegible]12	-4	9	-6	9	3	7

σ = Sigma Counting Error.

Table 16

Concentrations of Radionuclides in Pasteurized Milk

February 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
AL:MONTGOMERY	02/09/89	1.46	0.13	8	9	-1	9	8	7
AR:LITTLE ROCK	02/07/89	1.24	0.08	5	6	-2	6	3	5
AZ:PHOENIX	02/07/89	1.19	0.12	0	9	-3	9	6	7
CA:LOS ANGELES	02/03/89	1.31	0.12	6	9	-7	9	8	7
CA:SACRAMENTO	02/01/89	1.40	0.07	2	5	-4	5	3	4
CA:SAN FRANCISCO	02/10/89	1.51	0.13	9	9	0	9	8	7
CT:HARTFORD	02/06/89	1.48	0.12	1	7	-8	8	1	7
DC:WASHINGTON	02/08/89	1.39	0.12	-6	9	-2	9	0	7
DE:WILMINGTON	02/08/89	1.49	0.13	-4	9	3	9	7	7
FL:TAMPA	02/07/89	1.37	0.12	8	9	-8	9	4	7
GA:ATLANTA	02/02/89	1.24	0.12	3	9	-2	9	5	7
HI:HONOLULU	02/07/89	1.34	0.12	5	9	-6	9	8	7
IA:DES MOINES	02/02/89	1.48	0.09	6	6	-4	6	3	5
ID:IDAHO FALLS	02/03/89	1.55	0.16	12	10	-1	14	3	11
IL:CHICAGO	02/06/89	1.54	0.12	2	7	-9	8	1	7
IN:INDIANAPOLIS	02/06/89	1.40	0.09	-1	6	-5	6	4	5
KS:WICHITA	02/13/89	1.41	0.13	-4	9	-2	9	2	7
KY:LOUISVILLE	02/06/89	1.25	0.12	2	9	1	9	5	7
LA:NEW ORLEANS	02/17/89	1.38	0.12	2	9	-3	9	4	7
MD:BALTIMORE	02/03/89	1.45	0.09	4	6	-2	6	10	5
ME:PORTLAND	02/01/89	1.45	0.09	7	6	-6	6	3	5
MI:DETROIT	02/09/89	1.41	0.13	1	9	-1	9	8	7
MI:GRAND RAPIDS	02/06/89	1.36	0.12	4	9	-1	9	4	7
MN:MINNEAPOLIS	02/21/89	1.51	0.12	-1	7	-2	8	-2	7
MN:ST. PAUL	02/07/89	1.50	0.13	5	9	-7	9	6	7
MO:KANSAS CITY	02/10/89	1.48	0.12	2	7	-4	8	1	7
MO:ST. LOUIS	02/08/89	1.43	0.13	4	9	-3	9	3	7
MS:JACKSON	02/13/89	1.55	0.13	6	9	-7	9	2	7
MT:HELENA	02/23/89	1.36	0.12	1	9	0	9	5	7
NC:CHARLOTTE	02/13/89	1.46	0.22	5	14	-15	19	8	15
ND:MINOT	02/21/89	1.56	0.12	1	7	-7	8	-2	7
NE:OMAHA	02/10/89	1.26	0.12	9	9	0	9	4	7
NH:MANCHESTER	02/06/89	1.29	0.12	2	9	-4	9	-2	7
NJ:TRENTON	02/10/89	1.50	0.13	10	9	-3	9	3	7
NV:LAS VEGAS	02/13/89	1.31	0.12	2	9	-3	9	0	7
NY:BUFFALO	02/06/89	1.62	0.09	6	5	-6	6	1	5
NY:NEW YORK CITY	02/06/89	1.43	0.13	-5	9	-6	9	3	7

Table 16 (continued)

Concentrations of Radionuclides in Pasteurized Milk

February 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
NY:SYRACUSE	02/06/89	1.55	0.12	0	7	-7	8	0	7
OH:CINCINNATI	02/23/89	1.61	0.23	14	14	-4	19	-1	15
OH:CLEVELAND	02/14/89	1.32	0.12	9	9	1	9	6	7
OK:OKLAHOMA CITY	02/27/89	1.58	0.12	4	7	-2	8	4	7
OR:PORTLAND	02/07/89	1.56	0.12	3	7	1	8	7	7
PA:PHILADELPHIA	02/06/89	1.60	0.12	0	7	-4	8	3	7
PA:PITTSBURGH	02/13/89	1.61	0.12	4	7	-9	8	0	7
PC:CRISTOBAL	02/23/89	1.44	0.13	11	9	5	9	3	7
PR:SAN JUAN	02/13/89	1.39	0.12	0	9	-6	9	7	7
SD:RAPID CITY	02/10/89	1.48	0.12	4	7	2	8	-2	7
TN:CHATTANOOGA	02/06/89	1.61	0.12	7	7	-10	8	2	7
TN:KNOXVILLE	02/06/89	1.55	0.08	3	5	-4	6	2	5
TN:MEMPHIS	02/23/89	1.52	0.12	-2	7	-5	8	-2	7
TX:FT. WORTH	02/07/89	1.46	0.08	3	6	1	6	2	5
VT:BURLINGTON	02/02/89	1.40	0.13	4	9	-1	9	5	7
WA:SEATTLE	02/07/89	1.50	0.12	7	7	-8	8	8	7
WA:SPOKANE	02/08/89	1.60	0.12	3	7	-4	8	9	7
WI:MILWAUKEE	02/20/89	1.27	0.12	2	9	-4	9	5	7
WV:CHARLESTON	02/06/89	1.49	0.22	-9	14	-8	19	-7	14
WY:LARAMIE	02/09/89	1.56	0.12	3	7	-7	8	0	7

σ = Sigma Counting Error.

Table 17

Concentrations of Radionuclides in Pasteurized Milk

March 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	±2σ	pCi/l	±2σ	pCi/l	±2σ	pCi/l	±2σ
AL:MONTGOMERY	03/09/89	1.60	0.12	6	7	-7	8	-1	7
AR:LITTLE ROCK	03/07/89	1.35	0.12	2	9	-8	9	2	7
AZ:PHOENIX	03/08/89	1.33	0.12	1	9	1	9	6	7
CA:LOS ANGELES	03/08/89	1.62	0.12	-2	7	-11	8	2	7
CA:SAN FRANCISCO	03/09/89	1.50	0.09	5	6	-7	6	3	5
CO:DENVER	03/31/89	1.51	0.16	0	10	-9	13	4	11
CT:HARTFORD	03/06/89	1.50	0.08	1	5	-4	6	2	5
DC:WASHINGTON	03/10/89	1.38	0.12	-3	9	-4	9	3	7
DE:WILMINGTON	03/15/89	1.26	0.12	2	9	-16	10	10	7
FL:TAMPA	03/08/89	1.50	0.12	6	7	-1	8	0	7
GA:ATLANTA	03/13/89	1.30	0.12	4	9	-10	9	4	7
HI:HONOLULU	03/06/89	1.43	0.13	-1	9	-3	9	5	7
IA:DES MOINES	03/06/89	1.51	0.12	5	7	2	8	-2	7
IL:CHICAGO	03/07/89	1.51	0.13	0	9	-5	9	3	7
IN:INDIANAPOLIS	03/06/89	1.66	0.13	6	7	-6	8	-1	7
KS:WICHITA	03/20/89	1.27	0.12	0	9	-8	9	5	7
KY:LOUISVILLE	03/07/89	1.41	0.09	2	6	-6	6	3	5
MA:BOSTON	03/16/89	1.34	0.12	2	9	-7	9	0	7
MD:BALTIMORE	03/03/89	1.61	0.13	-2	7	5	8	-5	7
MI:DETROIT	03/08/89	1.54	0.12	2	7	-6	8	-2	7
MI:GRAND RAPIDS	03/13/89	1.37	0.12	-2	9	-10	9	0	7
MN:MINNEAPOLIS	03/13/89	1.39	0.12	4	9	0	9	0	7
MS:ST. PAUL	03/06/89	1.38	0.09	8	6	-7	6	5	5
MO:KANSAS CITY	03/08/89	1.61	0.12	1	7	-11	8	0	7
MO:ST. LOUIS	03/08/89	1.42	0.12	-2	7	-4	8	2	7
MS:JACKSON	03/07/89	1.53	0.12	6	7	-3	8	0	7
MT:HELENA	03/09/89	1.39	0.12	0	9	-6	9	6	7
NC:CHARLOTTE	03/13/89	1.42	0.22	5	14	-2	19	6	15
ND:MINOT	03/28/89	1.62	0.13	-3	7	-1	8	-1	7
NE:OMAHA	03/08/89	1.43	0.12	-6	6	1	8	-2	7
NH:MANCHESTER	03/04/89	1.39	0.12	6	9	-5	9	7	7
NJ:TRENTON	03/08/89	1.68	0.09	2	5	-7	6	2	5
NV:LAS VEGAS	03/09/89	1.48	0.12	0	7	-6	8	-6	7
NY:BUFFALO	03/13/89	1.37	0.12	1	9	-6	9	4	7
NY:NEW YORK CITY	03/06/89	1.43	0.12	0	7	-4	8	0	7
NY:SYRACUSE	03/06/89	1.34	0.12	-1	9	-5	9	6	7
OH:CINCINNATI	03/29/89	1.41	0.13	3	9	-4	9	1	7

Table 17 (continued)

Concentrations of Radionuclides in Pasteurized Milk

March 1989

Location	Date Collected	K		^{137}Cs		^{140}Ba		^{131}I	
		g/l	$\pm 2\sigma$	pCi/l	$\pm 2\sigma$	pCi/l	$\pm 2\sigma$	pCi/l	$\pm 2\sigma$
OH:CLEVELAND	03/28/89	1.58	0.09	0	5	-4	6	0	5
OK:OKLAHOMA CITY	03/20/89	1.32	0.12	-8	9	-1	9	4	7
OR:PORTLAND	03/06/89	1.58	0.12	6	7	-6	8	-7	7
PA:PHILADELPHIA	03/06/89	1.42	0.13	3	9	-6	9	6	7
PA:PITTSBURGH	03/08/89	1.54	0.12	-2	7	-6	8	1	7
PC:CRISTOBAL	03/29/89	1.48	0.09	5	6	-10	6	3	5
PR:SAN JUAN	03/10/89	1.59	0.12	0	7	-3	8	5	7
SC:CHARLESTON	03/13/89	1.54	0.12	6	7	-8	8	0	7
SD:RAPID CITY	03/07/89	1.40	0.09	0	6	-6	6	5	5
TN:CHATTANOOGA	03/06/89	1.31	0.12	8	9	-1	9	4	7
TN:KNOXVILLE	03/06/89	1.32	0.12	-2	9	1	9	4	7
TN:MEMPHIS	03/29/89	1.46	0.13	-3	9	-9	9	3	7
TX:AUSTIN	03/03/89	1.53	0.08	4	5	-4	6	-2	5
TX:FT. WORTH	03/09/89	1.34	0.12	5	9	-4	9	0	7
VA:NORFOLK	03/01/89	1.38	0.09	3	6	-5	6	4	5
VT:BURLINGTON	03/08/89	1.32	0.12	7	9	-4	9	0	7
WA:SEATTLE	03/07/89	1.45	0.09	1	6	-1	6	1	5
WI:MILWAUKEE	03/06/89	1.48	0.12	3	7	1	8	2	7
WV:CHARLESTON	03/07/89	1.62	0.23	-3	14	-4	19	4	15
WY:LARAMIE	03/08/89	1.35	0.12	-6	9	-4	9	4	7

σ = Sigma Counting Error.

Table 18

Strontium-90 and Strontium-89 in Pasteurized Milk
EPA Regional Composites

January - March 1989

EPA Region	Date	^{90}Sr pCi/l	$\pm 2\sigma$	^{89}Sr pCi/l	$\pm 2\sigma^*$
I	01/08/89	1.0	0.4	1	1
II	01/10/89	0.8	1.6	2	3
III	01/04/89	1.4	0.8	2	4
IV	01/08/89	1.6	0.9	0	4
V	01/07/89	2.3	0.7	-2	4
VI	01/06/89	1.3	1.1	1	2
VII	01/08/89	1.7	0.7	-2	4
VIII	01/10/89	1.7	0.6	-4	3
IX	01/06/89	0.1	1.3	1	2
X	01/07/89	1.4	0.6	-1	3

σ = Sigma Counting Error.
σ^* = Analytical Error Term.

Carbon–14 in Milk

Nine stations, chosen for wide geographical distribution, contribute milk samples for annual analysis of carbon–14. These samples are monitored for carbon–14 levels in the food chain resulting from nuclear testing. The pasteurized milk is freeze-dried and the resulting powder is pelletized for ease of combustion. Analysis consists of combusting the samples and measuring released carbon dioxide through liquid scintillation. The last carbon–14 results were for samples collected during April–May 1982 and March–May 1987. They were published in *Environmental Radiation Data: Report 54*.

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